Research on structures and advanced composites

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Abstract

Topology optimization was applied to the design of the wing structure of a transport eVTOL, and a demonstration study from design to manufacturing was conducted to confirm its feasibility.

Reasons and benefits of using JAXA Supercomputer System

To perform numerous cases of topology optimization and obtain numerous design idea.

Achievements of the Year

Topology optimization was applied to the design of the wing structure of a transport eVTOL, and a comprehensive study was conducted from design to manufacturing. As a result, it was confirmed that by appropriately converting the optimal reinforcement plan(Fig.1) obtained by topology optimization into path data(Fig. 2) for TFP (Tailored Fiber Placement), it is possible to fabricate an integrated carbon fiber preform(Fig. 3), which can be fabricated as a composites structural member(Fig.4).

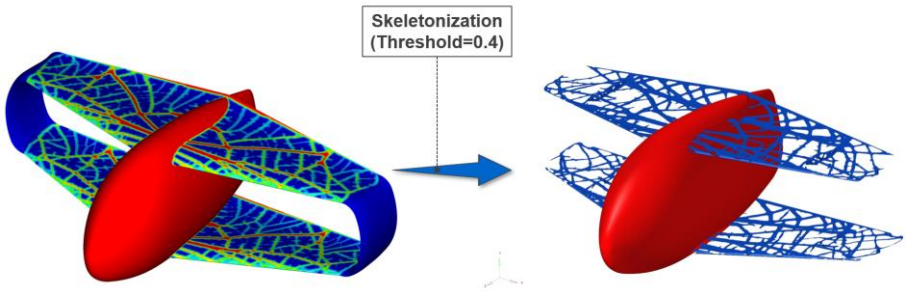

Fig. 1: Optimal reinforcement layout obtained by topology optimization(Contour: density ratio)

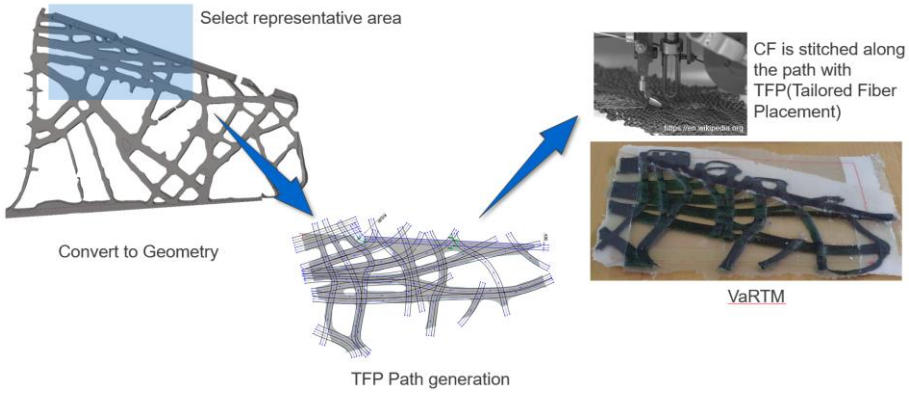

Fig. 2: Composites fabrication process

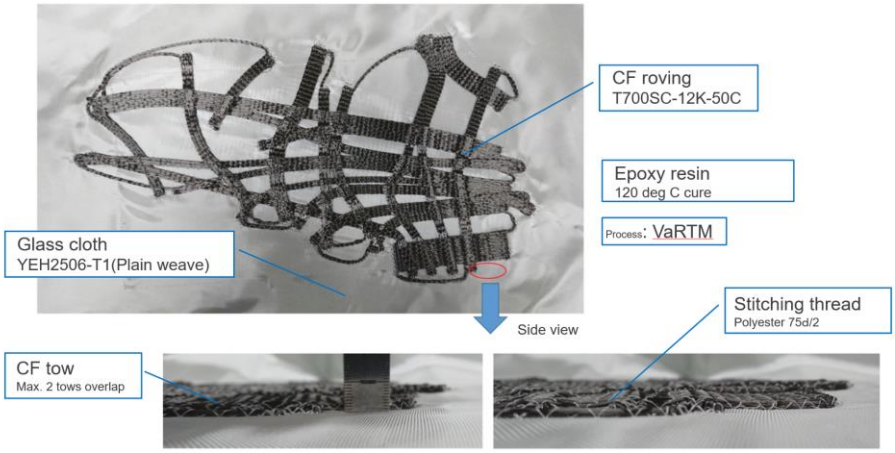

Fig. 3: Carbon fiber preforms fabricated by tailored fiber placement

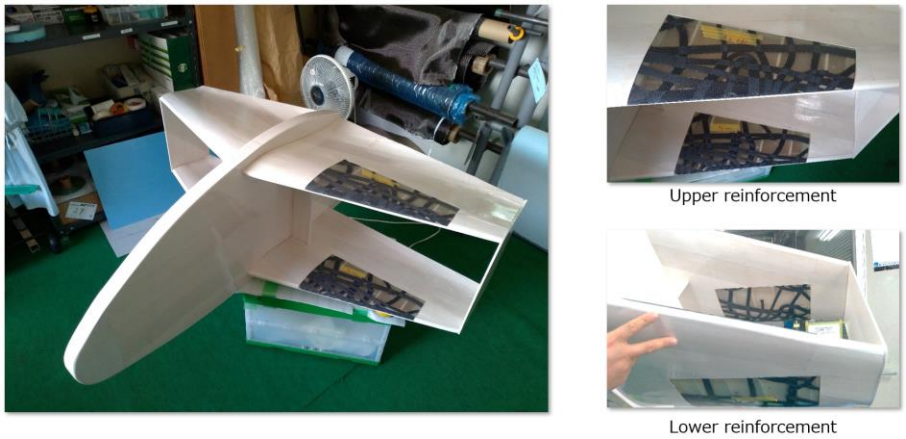

Fig. 4: Implementation in eVTOL mockup

Publications

- Non peer-reviewed papers

Yuichiro Aoki et. al., Development of eVTOL airframe structure desgned by topology optimization, Reinforced Plastics, Vol 68, No. 3, p.89-91, March 2022

- Invited Presentations

Yuichiro Aoki, Pursuit of novel light weight composite structures, 2nd International Conference on Additive Fabrication of Composites, 23-24 November 2021

Usage of JSS

Computational Information

Process Parallelization Methods	MPI
Thread Parallelization Methods	Automatic Parallelization
Number of Processes	2 - 200
Elapsed Time per Case	3600 Second(s)

- **JSS3 Resources Used**

Fraction of Usage in Total Resources[*1](%): 0.00

Details

Computational Resources		
System Name	CPU Resources Used (core x hours)	Fraction of Usage[*2](%)
TOKI-SORA	0.00	0.00
TOKI-ST	2,592.06	0.00
TOKI-GP	0.00	0.00
TOKI-XM	0.00	0.00
TOKI-LM	0.00	0.00
TOKI-TST	0.00	0.00
TOKI-TGP	0.00	0.00
TOKI-TLM	0.00	0.00

File System Resources		
File System Name	Storage Assigned (GiB)	Fraction of Usage[*2](%)
/home	15.00	0.01
/data and /data2	51,350.00	0.55
/ssd	150.00	0.04

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage[*2](%)
J-SPACE	0.00	0.00

[*1]: Fraction of Usage in Total Resources: Weighted average of three resource types (Computing, File System, and Archiver).

[*2]: Fraction of Usage：Percentage of usage relative to each resource used in one year.

- **ISV Software Licenses Used**

ISV Software Licenses Resources		
	ISV Software Licenses Used (Hours)	Fraction of Usage*2(%)
ISV Software Licenses (Total)	0.00	0.00

*2: Fraction of Usage：Percentage of usage relative to each resource used in one year.